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EXAMINER

AFREMOVA, VERA

ART UNIT	PAPER NUMBER
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1651

DATE MAILED: 02/20/2002

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/478,690

05/284,652

Applicant(s)

Melis Anastasiois et al.

Examiner

Vera Afremova

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on Apr 9, 2001
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-10 is/are pending in the application.
- 4a) Of the above, claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-10 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are objected to by the Examiner.
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

- 13) ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).
- a) ☐ All b) ☐ Some* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

*See the attached detailed Office action for a list of the certified copies not received.

- 14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

- 15) ☒ Notice of References Cited (PTO-892) 18) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 16) ☒ Notice of Draftsperson's Patent Drawing Review (PTO-948) 19) ☐ Notice of Informal Patent Application (PTO-152)
- 17) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s). 4 20) ☐ Other:

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DETAILED ACTION

Claims 1-10 are pending and under examination.

Claim Rejections - 35 USC § 112

Claims 1-10 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 1 is indefinite with regard to the concepts of "microorganism", "medium" and "gas".

04 With regard to a microorganism it is not particularly clear whether one kind of microorganisms is intended or more than one. A microorganism of claim 1 is not identified as a photosynthetic microorganism or photo heterotrophic microorganisms or at least photo metabolically active microorganism having a photosystem. Thus, it is not certain whether one or two microorganism are intended because the presence of an algal culture, for example, is required only for the process of claim 2 {see claim 6 and 10, for example}.

04 Although the process is intended for a production of oxygen and hydrogen, it appears that the final step e) as claimed does not result in the production of either oxygen or hydrogen but it results in evolution of some generic "gas". Thus, it is unclear whether any "gas" is produced or generated or whether the process of the step e) drawn to some changes within the whole atmosphere of the sealed culture/container {see step c), for example}. What is a meaning of a "temporal separation of oxygen evolution and hydrogen production"? Is/does some oxygen

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present/produced when hydrogen production takes place? Further, "the" temporal separation appears to lack antecedent basis. What is the difference between two terms such as gas evolution and gas production (generation, induction). What is the difference between the claimed phrases "evolution of oxygen" and "hydrogen production"? How much of "evolved" oxygen is allowed to separate in time (temporal separation) a hydrogen production from an oxygen generation as intended? Is it a complete separation in time? What are time periods?

With regard to "medium" {(see steps a) and b)} and with regard to "a nutrient" which is depleted from "the medium" it is unclear whether this nutrient was present in the original microbial culture medium and it was eventually used/depleted during microbial grow and accumulation of an endogenous substrate. Or whether was the original culture medium replaced by another medium? It is unclear what components are required in "medium" besides water (see claim 2, for example). Is it a microbial nutrient medium or a medium meaning buffer or water? It is uncertain whether a depleting step is an active step such as changing a nutrient medium to another medium or whether a depleting step is an inherent process as result of growing microorganisms and, thus, depleting nutrients in the medium.

Claim 1 is also indefinite with regard to the use of light energy because it is not particularly clear whether or not some differences are intended between "illuminated conditions" (step a) and "light" (step d).

With respect to the claim 2 it is uncertain when a generation of hydrogen from water takes place in the process of claim 1. Thus, it is uncertain when a "temporal" separation of oxygen and

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hydrogen production occur in the claimed process. It is unclear as claimed whether or not some amounts of oxygen are allowed during hydrogen production stage?

With respect to the claim 2 it is also unclear as claimed whether "a hydrogenase" is an enzyme produced by a microorganism of the claim 1 or by microorganism of claims 6 and 10 such as "endogenous substrate", for example, or whether "a hydrogenase" is an additional component/ingredient which is incorporated into the whole culture system from outside and which is not produced by one or all of microorganisms sealed in the culture/container.

Claim 4 appears to lack antecedent basis for "a head gas". Thus, it is unclear as claimed when an inert gas is introduced or when nitrogen (see claim 9) is introduced during the whole process of a temporal separation of various gas production/evolution.

With respect to the claim 5 it is not particularly clear whether "a plurality of cycles" are intended with an atmosphere of a head/inert/nitrogen gas or whether an atmospheric oxygen is required/allowed at least for growing a microorganism as it appears to be encompassed by a process of the sealing step c). It is not particularly clear because the atmosphere or gas of the step a) is not identified as claimed. It is also uncertain during what step of the process or when a "temporal" separation of oxygen and hydrogen takes place in the plurality of cycles.

Claim 8 is indefinite because it is not particularly clear whether "the substrate" is an accumulated "endogenous substrate" or whether "the substrate" as claimed is a component of a microbial culture "medium" such as first culture medium or an inorganic nutrient depleted medium.

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Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-9 are rejected under 35 U.S.C. 102(b) as being anticipated by US 4,010,076 [A].

Claims are directed to a process of a temporal separation of oxygen and hydrogen production by a microorganism having a physiologically active photosystem wherein the process comprises steps of growing the microorganism in medium under illuminated conditions in order to accumulate endogenous substrate, depleting nutrients including sulfur, iron or manganese from the medium, sealing the microorganism from atmospheric oxygen, incubating the sealed microorganism under illuminated conditions and collecting gaseous products. Some claims are further drawn to hydrogen evolution/generation/production from water and accumulated substrate under illuminated conditions. Some claims are further drawn to the use of inert gas or to the use/evolution/production of nitrogen with the sealed system. Some claims are further drawn to a repetition of process or to a plurality of cycles. Some claims are further drawn to the use of algal cultures. Some claims are further drawn to accumulation of endogenous substrates such as acetate or carbohydrate or proteins.

US 4,010,076 [A] discloses a process of a temporal separation of oxygen evolution and hydrogen production by a microorganism having a physiologically active photosystem such as

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Rhodospirillum rubium (example 1 or table 1) wherein the process comprises steps of growing the microorganism in a medium and, thus, accumulating endogenous substrates and depleting all nutrients whether organic or inorganic and obtaining the "spent" culture medium (col.3, line 66), step of sealing the prepared spent medium with microorganisms (col. 4, lines 2-3) in atmosphere of inert gas or argon (col. 3, line 68), incubating the sealed microorganism under illuminated conditions (col.4, line 4) and collecting evolved gaseous products. The whole process encompasses the use of light energy or the use of illuminated conditions to generated gas (example 1 or col. 2, lines 35-39). The disclosed method teaches a temporal separation or generation of various "evolved" gas products including nitrogen or hydrogen by using various substrates (col. 3, lines 33-40 or table 1) or generation of hydrogen from water by algal culture including *Chlamydomonas sp.* (see table 1). Although, the cited method is not particularly clear whether inorganic nutrients such as sulfur, iron or manganese are present in the amounts of 0.5 millimolar "or less" as required by the presently claimed method, it is reasonably expected that the "spent" medium which is used in the cited method inherently encompasses the use of medium without these inorganic nutrients as required fro the claimed method by the virtue of phrase "less".

Thus, the claimed method appears to be anticipated by the method of the cited patent at least in the light of indefiniteness of major terms and concepts as intended.

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Claims 1-8 and 10 are rejected under 35 U.S.C. 102(b) as being anticipated by US 4,442,211 [IDS-1].

Claims 1-8 as explained above. Claim 10 is further drawn to the use of algal culture or *Chlamydomonas reinhardtii*.

US 4,442,211 [IDS-1] discloses a process of a "temporal separation" of "oxygen evolution" and "hydrogen production" by a microorganism such as *Chlamydomonas reinhardtii* wherein the process comprises steps of growing the microorganism in medium under illuminated conditions in order to accumulate endogenous substrate and, thus, depleting nutrients including sulfur, iron or manganese from the medium, step of sealing the microorganism from atmospheric oxygen and/or incubating the microorganism under illuminated conditions or in the light in an environment free from atmospheric oxygen and carbon dioxide, passing inert gas through the culture system and collecting "evolved" gaseous products. The disclosed method teaches hydrogen generation from water and accumulated substrates under illuminated conditions (col. 1, lines 60-68 and col. 2, lines 1-3). The disclosed method encompasses the use of helium as an inert gas (col.1, line 64). The cited patent also encompasses a repetition of the process steps or a plurality of cycles (col. 3, lines 32-45). Although, the cited method is not particularly clear whether sulfur, iron or manganese in the medium were depleted to concentration of 0.5 millimolar or less as required by the presently claimed method, it is reasonably expected that the growing step inherently results in the depletion of these inorganic nutrients particularly in view that the

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starting or original culture medium contains these compounds as "trace elements" (col. 2, lines 54-55).

Thus, the claimed method appears to be anticipated by the method of the cited patent particularly in the light of indefiniteness of major terms and concepts such as "temporal separation" of oxygen and hydrogen, for example, wherein it is uncertain as claimed when these gas products are separated in time, how much of these products are separated and/or allowed to be present in the same culture system intended for the whole process.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over US 4,442,211 [IDS-1] and US 4,010,076 [A] taken with Wykoff et al. [U] and Melis [IDS-2-1]. *aff. deriv.*

Claims are directed to a method for temporal separation of oxygen evolution and hydrogen production by microorganisms including algal cultures belonging to *Chlamydomonas* sp. and *Chlamydomonas reinhardtii* which is induced by nutrient depletion from the culture medium.

The cited patents US 4,442,211 [IDS-1] and US 4,010,076 [A] are relied upon as explained above. They are lacking particular disclosure and/or motivation related to the induction

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of a temporal separation of oxygen evolution and hydrogen production by microorganisms as the result of a controlled nutrient depletion from the culture medium.

The cited reference by Wykoff et al. [U] teaches that decline of oxygen evolution by photosynthetic organisms is induced by nutrient starvation and that the photosynthetic evolution of oxygen in a culture of *Chlamydomonas reinhardtii* is induced by sulfur starvation or depletion of sulfur from the culture medium (abstract). In addition, the reference by Melis [IDS-2-1] teaches a temporal separation of microbial oxygen and hydrogen production by applying stress conditions to the microbial culture.

Therefore, it would have been obvious to one having ordinary skill in the art at the time the claimed invention was made to modify the prior art methods of the cited patents US 4,442,211 [IDS-1] and US 4,010,076 [A] by introducing an active step directed to nutrient depletion or sulfur starvation with a reasonable expectation of success in temporal separation of hydrogen and oxygen production because the prior art teaches that nutrient depletion from the culture medium results in the decline of photosynthetic oxygen production as suggested by the Wykoff et al. [U] reference while hydrogen is produced from water by illuminated and photo metabolically active microorganisms as taught by US 4,442,211 [IDS-1] and US 4,010,076 [A]. Thus, the claimed invention as a whole was clearly prima facie obvious, especially in the absence of evidence to the contrary.

The claimed subject matter fails to patentably distinguish over the state art as represented by the cited references. Therefore, the claims are properly rejected under 35 USC § 103.

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Priority

Applicants' claim for domestic priority under 35 U.S.C. 119(e) based on benefits of the provisional application 60/173,391 filed 12/28/1999 (see specification page 1, par. 1) is acknowledged. However, it is not properly claimed and/or absent in the declaration which is present in the contents of the instant file 09/748, 690. The provisional application 60/214, 380, which is presently indicated in the applicants' oath and declaration, does not appear to be related to the claimed subject matter and to the disclosed subject matter. Appropriate clarification and/or correction to the applicants' declaration is required.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Vera Afremova whose telephone number is (703) 308-9351. The examiner can normally be reached on Monday to Friday from 9:00 to 5:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Wityshyn, can be reached on (703) 308-4743. The fax phone number for this Group is (703) 308-4242.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0196.

Vera Afremova

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February 15, 2002.

V.A .

SANDRA E. SAUCIER
PRIMARY EXAMINER

